

# Report from the Summer Meeting of the Physics Advisory Committee

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Users' Meeting

June 27, 2000



# Report from Aspen

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Fermilab benefits from having an excellent Physics Advisory Committee. The members are:

Peter Meyers, Princeton (Chairman),

Giorgio Belletini, Pisa

Robert Cousins, UCLA

Nick Hadley, Maryland

Joe Lykken, Fermilab

Shoji Nagamiya, KEK

Ronald Poling, Minnesota

Natalie Roe, LBL

Leslie Camillieri\*, CERN

Adam Falk, Johns Hopkins

Andreas Kronfeld\*, Fermilab

Frank Merritt, Chicago

Michael Peskin, SLAC

Jeffrey Richman, UCSB

Jim Virdee, CERN

Taiji Yamanouchi, Fermilab (Secretary)

\*members whose terms ended with this meeting



# Charge to the PAC

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- Recommendation on BTeV
- Comments on Run II
- Discussion of Future Options
- Recommendation on P-916, forward detector at CDF



# BTeV Status as of April, 2000

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- The collaboration will submit a proposal this summer.
  - The PAC will review it at Aspen.
  - It needs to be a flagship experiment of the world B physics program in the period 2006 and beyond.
  - The collaboration must demonstrate their ability to measure these difficult modes with modest background.
- The laboratory will understand the cost and impact on the Fermilab program. We must understand
  - the cost better than is usually done.
  - the engineering requirements.
  - the impact on collider operation.
- Funding prospects for the laboratory and outside funding prospects for BTeV will also be considered.



# BTeV Recommendation

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- “The BTeV collaboration proposes an ambitious program of measurements with a new detector at the C0 intersection region of the Tevatron collider, the main focus being the study of CP violation using B and Bs mesons. Noting the extensive array of running and approved B experiments, the Committee set a very high threshold for approval of BTeV.”
- “The Committee has spent a major part of its effort over the past three years on the consideration of the BTeV experiment. For the final phase of its consideration, the Committee received in May the formal BTeV proposal.
  - The Committee also received evaluations from the various Laboratory divisions of the overall BTeV cost, schedule, and manpower requirements, the technical feasibility of the BTeV trigger, the requirements for the C0 interaction region, and the overall picture of Laboratory resources.
  - The Committee is grateful to the Directorate and the division heads for providing us with these very useful studies.”



# BTeV Recommendation

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- “Based on all of this information, the Committee has come to the following conclusions:
  - The physics of CP violation in the B system will still be compelling when BTeV runs, with important measurements still needed to test our theories of its origin.
  - BTeV has proposed a very powerful detector. Its pixel-based tracker, detached-vertex Level 1 trigger, RICH particle ID system, and lead tungstate electromagnetic calorimeter make it capable of measuring the full suite of CP violation parameters in the B system. BTeV’s physics reach exceeds that of all other experiments in some of these important measurements.
  - The BTeV collaboration has done excellent work in developing the advanced technologies needed to make the experiment possible, and in deploying the simulation and analysis tools needed to make its physics case.”



# BTeV Recommendation

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- “The Committee believes that BTeV has the potential to be a central part of an excellent Fermilab physics program in the era of the LHC. With excitement about the science and enthusiasm for the elegant and challenging detector, **the Committee unanimously recommends Stage I approval for BTeV.**”



# BTeV Recommendation

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- “The Committee had extensive discussions of the impact of BTeV on the ability of the Laboratory to carry out the other parts of its physics program.
  - The Committee reiterates that the highest priority of the Laboratory in the coming decade is Run 2 of the Tevatron, and the most exciting goal of this program is the discovery of the Higgs boson or other new physics.
  - The Laboratory’s efforts to develop, construct, and install BTeV absolutely must not be allowed to interfere with the discovery potential of Run 2.
  - The Committee also reiterates the importance of the NuMI/MINOS program, which should continue to be supported as planned.”





# BTeV Recommendation

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- Significant material and intellectual resources will be dedicated to the accelerator upgrades needed for Run 2b and to accelerator R&D for long-term projects.
- The construction, installation, and commissioning of a new interaction region at C0 will be an additional burden.
- The Committee urges the Laboratory to manage this aspect of the mounting and startup of BTeV with utmost care.
- The Committee stresses that all decisions about the use of the Tevatron in this period must reflect the unambiguous priority of maximizing the physics discovery potential of Run 2.



# Comments on the BTeV Physics Program

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- The program of measuring a comprehensive set of CP asymmetries will not be completed by the present experiments.
- The best chance for seeing new physics is in the loop diagrams contributing to  $B_d$  and  $B_s$  mixing. This is done by
  - measuring precisely the CP asymmetries in certain  $B_d$  and  $B_s$  decays with little or no theoretical uncertainties.
  - comparing these measurements to the predictions from the amplitudes of the CKM elements extracted from semileptonic decays and B mixing.



# Comments on BTeV Physics Program

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- BTeV could be the definitive experiment that ultimately clarifies the picture of CP violation.
- The most important CP parameters to measure precisely are:
  - $\beta_d$  from  $B_d \Rightarrow \psi K_s$
  - $\alpha_d$  from  $B_d \Rightarrow \rho\pi$  (time-dependent Dalitz-plot)
  - $\gamma_s$  from  $B_s \Rightarrow D_s K$  (four time-dependent rates)
  - $\chi_s$  from  $B_s \Rightarrow \psi\eta, \psi\eta', \psi\phi$
- Only the first of these will be precisely measured before 2006.
- The BTeV detector design makes it ideally suited to making precise measurements of the other quantities.



# The Laboratory's Response

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- The BTeV physics program will still be compelling late in this decade.
- The BTeV detector will be unparalleled in its ability to do the most important measurements.
  - pixel vertexing system, 6 mm from the beam
  - level-1 trigger system that maintains high efficiency for all B decays
  - RICH + forward detector => excellent particle ID
  - $\text{PbWO}_4$  calorimeter + forward detector => excellent  $\gamma$  detection
- The cost is known as well as possible at the proposal stage.
- It will be possible to preserve the full physics potential of Run 2b, and we will do so.
- It is important for Fermilab and the US HEP program to have such an excellent experimental program late in the decade.



# The Laboratory's Response

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- **I have accepted the recommendation to give Stage I approval to BTeV.**



# More on BTeV



- The PAC did an enormous amount of work over the last year and especially in Aspen before reaching a position on BTeV.
  - The members entered the process with proper skepticism about approving any large new experiment.
  - The discussion included issues that are more usual to a HEPAP subpanel: planning for the future and the benefit to US HEP.
  - They understood that this was an important and difficult issue.
  - The PAC recommendation and report will be posted on the web.
- BTeV represents the most important experimental program that can be done in the U.S. program at the end of this decade before the completion of a major new facility.
  - It also affords the opportunity to develop and build detector technology that is at the level of the best in the world.



# Laboratory Priorities

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- “The highest priority of the laboratory has been and continues to be Run 2 of the Tevatron Collider.”
- “The Laboratory must put a strong emphasis on achieving the highest integrated luminosity that it can during Run 2.
  - We commend the Beams Division for its ambitious plans and for its ideas for increasing Run 2 luminosity far above levels previously attained.
  - More attention and additional laboratory resources, including skilled technical personnel, should be devoted to maximizing the integrated luminosity of Run 2.”



# CDF/D0 Run 2b Upgrades

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- “Achieving the physics goals of the Tevatron collider program before LHC turn-on is the Laboratory’s highest priority.”
- “It is therefore imperative that the scope of the upgrades be defined very soon, that the plans require limited R&D with realistic goals, and the necessary downtime for installation and commissioning be minimized.”





# Future Options

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- The PAC heard reports from all of the Fermilab R&D programs on accelerators of the future.
- The members of the PAC commented on the progress of and plans for these efforts
  - support for the fast start of the new NLC collaboration
  - praise for the neutrino factory reports, both accelerator and physics
  - endorsement of the plans for the continuation of SC magnet R&D
- The members recognized the importance of increasing the focus on Run 2b while maintaining these R&D efforts.
- There will be a more extensive discussion of these issues at the 2001 meeting, before the Snowmass meeting.

## P-916: Study of Hard Diffraction and Forward Physics at CDF

- “The Committee recommends Stage I approval.”
- “This approval should be subject to the condition that no engineering resources be diverted from baseline Run 2 preparations to this project.”